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Cryptocurrency: The Argument for its Allocation Within the Traditional Investor's Portfolio

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Cryptocurrency: The Argument for its Allocation Within the Traditional Investor's Portfolio

by

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Abstract

        This research explores the significance of cryptocurrencies upon the "traditional" investor's portfolio, particularly elaborating on the potential returns and advocating for its allocation within any balanced (or diversified) portfolio.

        Cryptocurrencies are a relatively new asset and are still considered to be extremely risky. They are characterized by ever-fluctuating prices, ongoing government regulation, and overall market skepticism. However, the potential of major cryptocurrencies (Bitcoin, Ripple, Ethereum, and Litecoin) to produce major returns cannot be easily ignored. This paper builds upon the research of those in academia, as well as highly respected investors. The hope is to outline both the pros and cons of investing in "risky" assets, such as Bitcoin, and why it is an important part of any, truly, diversified portfolio.

        Utilizing data from Bloomberg Professional Services, government websites, and other reliable sources, this paper examines a balanced portfolio, as well as a group of five theoretical portfolios. The 5 portfolios consist of different percentage allocations of equity, fixed-income, and Bitcoin. Furthermore, the portfolio is divided into "active" and "passive" strategies, with regards to Bitcoin (only). The results show that the portfolios with higher allocations of Bitcoin perform better, overall, as compared to the portfolios with lower allocations of Bitcoin. Additionally, the results also show that an active strategy (with the same portfolios) yields much more promising returns than a passive strategy.

        Although cryptocurrencies are an extremely new asset, it is important to understand their true investment value (or worth). With so much hysteria surrounding them, evaluating their actual performance within a portfolio is critical for a long-term understanding. It can also provide direction for future research in the field of cryptocurrencies.

This honors thesis is approved for recommendation.

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Introduction:

The need for an understanding of cryptocurrencies is paramount in today's world. With mass hysteria setting in, people are investing unprecedented amounts of money into these assets. However, it is still quite unclear whether that so called "fear of missing out" is warranted or not. While early investors of major cryptocurrencies, like Bitcoin, have seen tremendous returns in the last few years, many remain skeptic on the future of this bullish run. In short, a lot is still left to be determined, regarding the fate of cryptocurrencies.

The focus of this paper is centered on the argument for proper allocation of Bitcoin within any well-diversified portfolio. The research conducted focuses on the utilization of data in Bloomberg Professional Services to create theoretical portfolios and assess their performances. The theoretical portfolios seek to mimic that of a balanced portfolio, which consists of equity, fixed-income, and Bitcoin.

Different stratifications of each portfolio are constructed purposefully to examine the effects of Bitcoin on the overall performance of the portfolio. Furthermore, different investment strategies (passive and active) are considered to see if an even higher return is possible within the portfolios. The goal is to show that although Bitcoin is considered "risky", it should be included in the portfolio of any traditional investor.

This paper is divided into seven sections: a literature review, the cryptocurrency context, the model, data, analysis and results, potential limitations, and the conclusion. The literature review focuses on past research conducted in the field of cryptocurrencies. The next section, the cryptocurrency context, describes a brief history of cryptocurrencies and seeks to shed light on some of the jargon in the space that is causing so much "buzz". In the third section, the model, an explanation of how the portfolios were set up and why the securities in each were chosen is given. Data, the fourth section, shows how the model influenced the structure of the five theoretical portfolios. The fifth section, analysis and results, presents the subsequent findings in the data to evaluate what took place. The sixth section will discuss the limitations that were encountered throughout the formation of this paper. Lastly, the seventh (and final) section of the paper presents a summary of the research, as well as the major findings. It also mentions potential limitations, throughout the study, and proposes what other research can be conducted in the future to shed more light on the subject.

I – Literature Review:

Cryptocurrency is the future, and the future is coming fast. With so much already going on in the fintech space over the last few years, it was only a matter of time until a truly digital currency presented itself. However, although many cryptocurrencies have started popping up in the last year or so, it is important to remember that the original, Bitcoin, first appeared in 2009. Within only two years of its launch, Bitcoin amassed billions of dollars in economic value. That economic value has only increased since. In fact, in December of 2017, the value of one (single) Bitcoin neared $19,000 (as seen in diagram 1). In total, the cryptocurrency market is worth somewhere around $700 billion today. With so much money pouring into this new and cutting-edge space, it is only fitting that there be some research advocating for its continued investment.

Bitcoin Historical Price Chart:
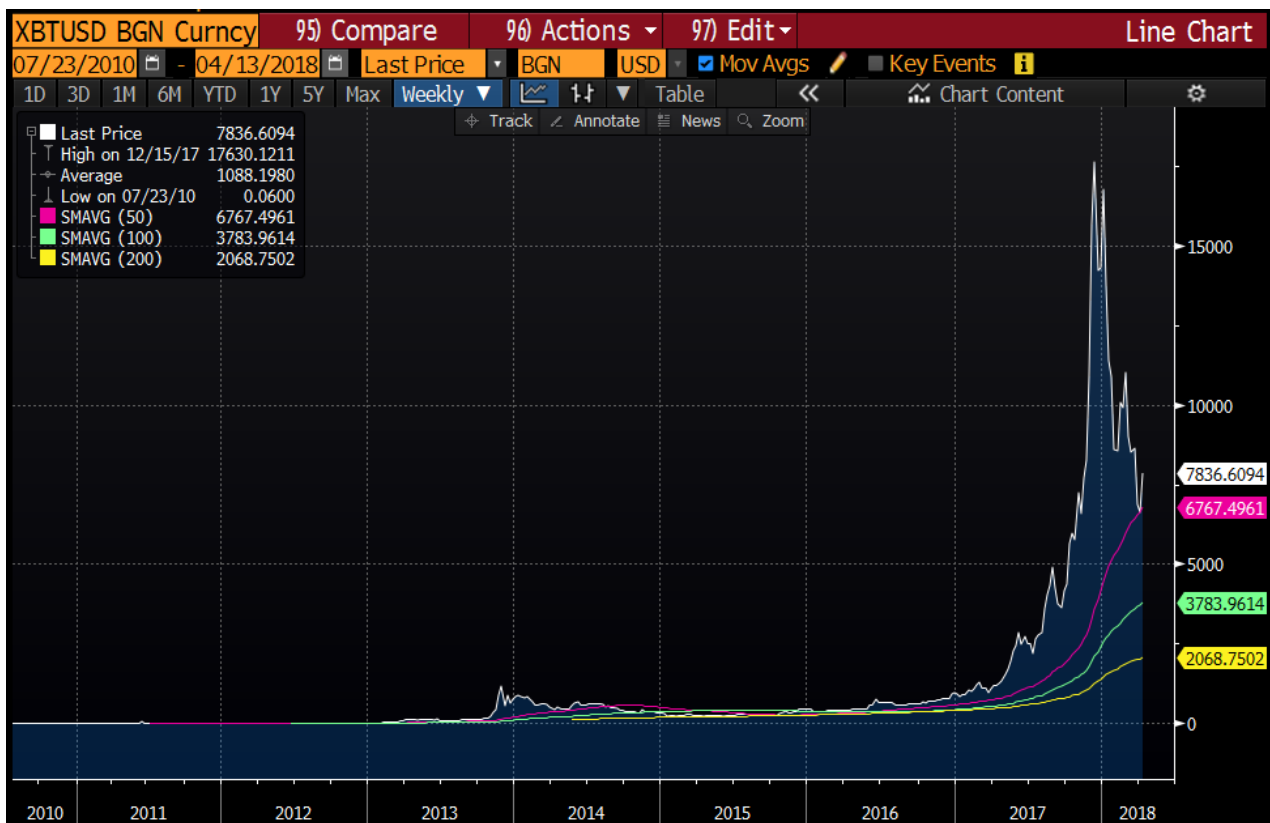
[Diagram 1 – source: Bloomberg]

Frequently, the value of something is interpreted through mere supply and demand. Basic economics, yes, but important nonetheless. In their paper, "The Economics of Cryptocurrencies –

Bitcoin and Beyond", authors Jonathan Chiu and Thorsten V. Koeppl take a closer look at this very subject. Even though they agree that aspects of Bitcoin are inefficient (costly mining fees, delayed settlement, and so on), the two conclude that Bitcoin still has tremendous potential because of its massive (and still growing) user base. In fact, they go on to say that, in their eyes, an optimal design for the cryptocurrency could be adopted soon, once the currency becomes "mainstream". The improved design would reduce the need for mining by, instead, focusing exclusively on money growth, rather than transaction fees to finance mining rewards. Furthermore, the two also point out that cryptocurrencies can potentially revolutionize the current payment systems provided by most retailers. This should put fear into the minds of companies like PayPal, Stripe, and Skrill who rely solely on the ability to charge fees for their services.

In another study, done by David Lee Kuo Chuen, Li Guo, and Yu Wang, the authors analyze the investment potential of Bitcoin (as well as other cryptocurrencies). Throughout their paper, they advocate the pros of investing in Bitcoin. First off, they present the idea that cryptocurrencies should, mainly, be viewed as alternative investments: commodities, real estate, private equity, hedge funds. They also point out that use of alternative investments in balanced portfolios is quite common. Their main reasoning for this is diversification purposes. In their own words, "alternative investments have a lower historical correlation to conventional asset classes, such as stocks, bonds, and cash equivalents, thus providing good diversification to the overall portfolio". Even though there is a lot to be sorted out, regarding the true valuation of Bitcoin (and other similar cryptocurrencies), there is an undeniable play on diversification here. Yes, the risks are high, but the returns prove that it is quite worth it.

Secondly, the same study (Cryptocurrency: A New Investment Opportunity?), as mentioned in the previous paragraph, goes on to show that the effects of cryptocurrencies on the overall portfolio performance are substantially positive. Their results indicate that "cryptocurrencies can be a good option to help diversify portfolio risks because the correlations between them and traditional assets are consistently low, and the average daily return of most cryptocurrencies is higher than that of traditional investments. Furthermore, the plots of the efficient frontier illustrate that incorporation of cryptocurrencies significantly expands the efficient frontier, relative to traditional assets alone". Clearly, this begs for further exploration.

The "juiced" returns that cryptocurrencies can provide to a portfolio cannot be denied, and it doesn't hurt that they even add a new class for diversification.

An additional research paper, "SoK: Research Perspectives and Challenges for Bitcoin and Cryptocurrencies" provides great insight as to why Bitcoin and other cryptocurrencies need to be understood from an investment perspective. The authors seek to illuminate the public as to why Bitcoin is the next big investment in fintech. By carefully examining the cryptocurrency, the paper identifies the fact that "Bitcoin is filling an important niche by providing a virtual currency system without any trusted parties and without pre-assumed identities among the participants". In other words, Bitcoin is not only valuable from a pure price sense; it is valuable for reasons that might not even be fully understood yet. Much of the underlying technology surrounding Bitcoin might be just as valuable (if not more) as the actual currency itself. Blockchain technology, which will be discussed more later, is a key component of Bitcoin. The peer-to-peer networks that it generates, without the help of a 3rd party institution, could mean significant changes in the world of finance. Imagine a world where banks are no longer required to approve transactions – those are the types of implications involved with this groundbreaking technology.

This study will hope to mimic the findings in a paper, written by Mebane T. Faber, titled "A Quantitative Approach to Tactical Asset Allocation". By utilizing the previous framework established in that document, it will serve as an outline for the work carried out in the following sections of this research. However, the major difference and point of interest will be in evaluating Bitcoin by using a simple moving average as a means of trading. The active returns will be compared to the passive returns, in a hope that we can account for the frequent price changes in Bitcoin's value. In summation, it is necessary to see if a risky asset's downside can be negated by trading it against a simple moving average as a way of combatting large negative returns (or losses).

Bitcoin is sexy and flashy right now. It's a topic of much debate that won't be ending anytime soon. This paper seeks to contribute to the overall conversation. By studying the overall effects of Bitcoin within a (theoretically) diversified, or balanced, portfolio, a better understanding of the cryptocurrencies long-term implications and profitability might be easier to determine. However, to differentiate this study from previous studies, an emphasis will be placed on whether "active" versus "passive" trading strategies (with regards to Bitcoin) yield better

returns within the same portfolios. This creates an opportunity to examine something that has not been closely studied up this point. That is the ultimate focus of research performed ahead.

II – The Cryptocurrency Context:

To fully understand the true importance of this research, a greater perspective of the cryptocurrency context is necessary. First off, what exactly is a cryptocurrency? In short, "a cryptocurrency is a virtual coinage system that functions much like a standard currency, enabling users to provide virtual payment for goods and services free of a central trusted authority", according to Ryan Farell (at the University of Pennsylvania). Furthermore, cryptocurrencies rely on the transmission of digital information, utilizing cryptographic methods to ensure legitimate, unique transactions. However, Bitcoin took the digital coin market one step further by decentralizing the currency and freeing it from hierarchal power structures. Instead, individuals (and businesses) transact with the coin electronically on a peer-to-peer network.

Peer-to-Peer Network Explained:
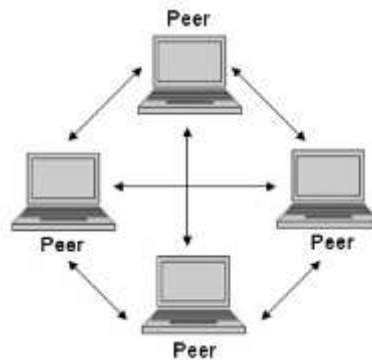
[Diagram 2 – source: theinfozones.com]

So, what is a peer-to-peer network then (see diagram 2)? Well, in its simplest form, a peer-to-peer network is created when two or more personal computers are connected and share resources without going through a separate server computer. Instead of having a central server to act as a shared drive, each computer acts as the server for the files stored upon it. More so, when a peer-to-peer network is established over the internet, a central server can be used to index files, or a distributed network can be established where the sharing of files is split between all the users in the network that are storing a given file. Essentially, Bitcoin is possible because of this peer-to-peer network.

A bitcoin, and every subsequent cryptocurrency, is merely a chain of digital signatures where each owner transfers the coin to the next by digitally signing a hash of the previous transaction and the public key of the next owner and adding these to the end of the coin so that ownership can dynamically be programmed into the coin. This process is the foundation of which the peer-to-peer network rests upon. The process to verify transactions through groups of people without any interaction of a 3rd party, such as a bank, government, and so on. However, the peer-to-peer network sets up the truly amazing aspect of bitcoin.

That aspect is the "blockchain". Bitcoin can only be sent (or received) by logging the transaction on the public ledger (also known as the blockchain). Bitcoins lack intrinsic value – their value is purely a function of supply and demand. Bitcoin is unlike any fiat currency, which derives its value from a government. In other words, Bitcoin is not created by (or backed by) any government.

Blockchain Explained:
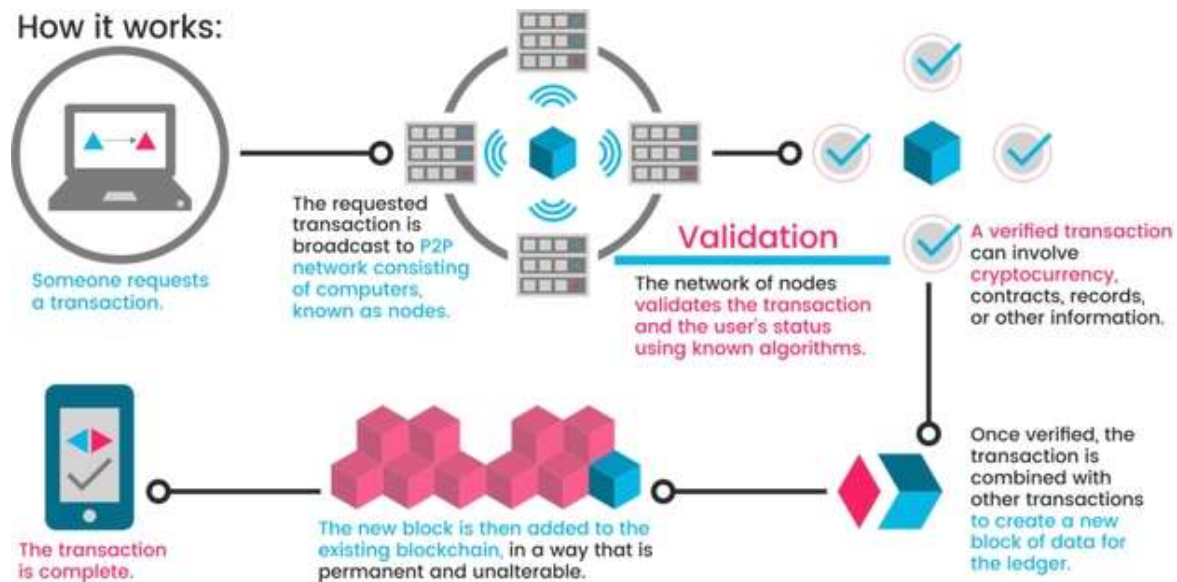
[Diagram 3: source – techloyce.com]

Blockchain technology (as seen in diagram 3) makes the peer-to-peer network possible. Essentially, it solves the double spending problem, which is inherent of non-cash payments systems, by keeping records of ownership and transactions timestamps. This eliminates the possibility of digital copying (or double spending). In other words, a transaction is only complete

and added to the blockchain once a required amount of computational data is used. This satisfies the "proof of work" requirement, which is inherent of Bitcoin. Only at that point, is the transaction considered complete – ownership is entirely transferred.

But what about 'mining'? Well, Bitcoin mining is the entire process that is undergone by each node. Effectively, miners (the nodes themselves) verify transactions in each block. In return for the service that Bitcoin miners perform, they receive transaction fees and newly minted coins (mined Bitcoins). "In this way, Bitcoin functions similarly to commodities like gold: the steady addition of a constant amount of new coins is analogous to gold miners expending resources to add gold to circulation". For that very reason, it is believed that in the long run, only about 21 million Bitcoin will circulate in existence. Eventually people will not have incentives to mine Bitcoins because it will no longer be efficient. Fees will be too costly and too many coins on the market would mean deflation of the actual cryptocurrency itself, depending on market conditions.

This leads the conversation to the potential downsides of Bitcoin. Although the purpose of this paper is to promote investment in Bitcoin, it is only fair to point out some of the most hotly debated topics with cryptocurrencies. For one thing, government regulation could present several pitfalls for cryptocurrencies before they become mainstream within society. Because cryptocurrencies are not universally accepted as a means of payment, developing standardized systems for their continued (and future) use is critical. To ultimately secure stability, their legal status must be established.

While countries like the USA have taken more of a neutral stance on cryptocurrencies, not all countries agree with this approach. Australia, who has yet to formally adopt any regulations on cryptocurrencies, does have the ability to tax the coinage since it is subjected to the county's existing tax rules. Meanwhile, Canada has, arguably, the most developed system of regulation, with regards to cryptocurrencies. In fact, the Bank of Canada has even expressed a willingness to acknowledge the developing virtual currency outright.

On the other hand, many other countries remain skeptical. Russia has major concerns over the digital currency market. They believe it will merely become a way to launder money. They also point out the fact that it violates federal law by not having any sort of central bank agency tied to it. Another country that is seeking to stop the spread of Bitcoin is China. The

county's central bank prohibits financial institutions from handling Bitcoin transactions, and citizens are being told to treat Bitcoin like a good rather than an actual currency.

Another major concern is the fact that Bitcoin is still widely misunderstood. In other words, the public perception of Bitcoin is still mostly one of confusion. For Bitcoin to truly become successful and "make it", it will first have to gain the public's trust. So much about cryptocurrencies is still unknown to the public. Plus, the fluctuation of Bitcoin's value doesn't make people feel any more at ease. Acceptance, by retailers, would likely go a long way in getting more people exposed to Bitcoin; however, many retailers are not willing to accept cryptocurrencies at this point because their overall usage in the market is relatively low. Until they reach a desirable threshold or volume of transactions, the wide acceptance of cryptocurrencies will be unlikely for most retailers.

The original question remains the same though: should Bitcoin be present in the traditional investor's portfolio? In the next few sections, that very argument is laid out analytically. Bitcoin is a useful alternative investment that can help to diversify a portfolio and produce favorable returns, especially in an active portfolio (versus a passive portfolio).

III – The Model:

As previously mentioned, a past study (by Mebane T. Faber), called "A Quantitative Approach to Tactical Asset Allocation", will be mimicked for the research conducted in this paper. In his study, Faber hoped to explore risk-adjusted returns across various asset classes. To do this, he took a departure from the original system of a diversified portfolio by adding more asset classes. This was accomplished by introducing various portfolio allocations and implementing alternative cash management strategies.

A theoretical portfolio is presented that contains several different asset classes, thereby making it diversified. The asset classes represent international indexes, national government securities, national REITs, national equity indexes, and national commodity indexes. The securities included in Faber's theoretical portfolio are listed below.

1) **USA 3-Month Treasury Bills**
2) **USA 10-Year Treasury Bonds**

3) **S&P 500 (SPX Index)**: American stock market index based on the market capitalizations of 500 large companies that have common stock listed on the NYSE or NASDAQ.

4) **MSCI EAFE (MXEA Index)**: a free-float weighted equity index. Used in the USA to measure international equity performance. Compromised of developed markets in Europe, Australasia, and the Far East.

5) **GSCI (SPGSIN Index)**: provides investors with a reliable and publicly available benchmark for investments performance in the industrial metals market.

6) **NAREIT (RUGL Index)**: designed to represent general trends in eligible real estate equities worldwide.

However, there is one more asset that needs to be considered (for this paper), which Faber didn't use: Bitcoin. That is the only difference (besides the time-frame analyzed) that was added so that a comparison could be made for the overall portfolio.

7) **XBTUSD**: Bitcoin to United States dollars cross-exchange rate.

The theoretical portfolio can be seen below. The time frame examined was March 30, 2011 – March 30, 2018 (for a total of 7 years).

Diversified Portfolio (3/30/2011 – 3/30/2018):

| | T-Bills | S&P 500 | MSCI EAFE | US 10-Year | GSCI | NAREIT | XBTUSD |
	USA 3-Month T-Bills	SPX Index	MXEA Index	USA 10-Year T-Bonds	SPGSIN Index	RUGL Index	Bitcoin
Return (Annualized)	0.33%	12.66%	5.86%	2.28%	-3.65%	6.95%	241.99%
Volatility	0.50%	9.45%	12.81%	0.42%	20.88%	14.10%	1785.32%
Sharpe Ratio	0.00	1.31	0.43	4.64	-0.19	0.47	0.14
Max DD	-1.36%	-11.40%	-12.21%	-1.28%	-12.18%	-15.76%	-112.88%
Inflation CAGR	1.68%	1.68%	1.68%	1.68%	1.68%	1.68%	1.68%

[Figure 1 – source: Bloomberg]

The variables considered for each asset are its return, volatility, Sharpe Ratio, max drawdown, and inflation CAGR. The "return" variable was a geometric average of annual returns over the given timespan. "Volatility" was simply the standard deviation (averaged geometrically for each year). The "Sharpe Ratio" is defined as the asset's return, subtracted by the risk-free rate (3-

month T-Bill), and divided by the asset's volatility. "Max drawdown" is the largest percentage drop for each asset over the given period. Lastly, "inflation CAGR" is the annual geometric average of each year's inflation percentage (provided by the United States Department of the Treasury). Seven years was used as the time frame because it gave the most holistic view of Bitcoin's price data.

As one can see (in figure 1), Bitcoin clearly has a high return. However, that 241.99% should probably be taken with 'a grain of salt'. After taking a closer look, it becomes evident that Bitcoin is subjected to extremely high volatility and a somewhat low Sharpe Ratio. The Sharpe Ratio, effectively, tells an investor how much excess return they are receiving for the extra volatility endured. Since Bitcoin's volatility is so high, this explains the low Sharpe Ratio (relative to other assets in the portfolio). However, this might not necessarily be a terrible thing. One could argue that the upside volatility of Bitcoin is much greater than its downside volatility (at least for the period examined). This could still explain the low Sharpe Ratio, but it would certainly ease potential investors knowing there is, likely, more good (than bad) being reflected in that number. Another figure that stands out, specifically for Bitcoin, is the max drawdown percentage. Max drawdown can be explained as the largest single drop from peak to bottom in the value of a financial security.

Portfolio Correlation Matrix:

Security	XBTUSD	SPX	MXEA	SPGSIN	RUGL	USBMMY	USGG10
XBTUSD	1.000	0.066	0.002	-0.009	0.058	0.025	-0.042
SPX	0.066	1.000	0.446	0.181	0.477	0.011	0.295
MXEA	0.002	0.446	1.000	0.267	0.545	-0.083	0.169
SPGSIN	-0.009	0.181	0.267	1.000	0.106	-0.101	0.175
RUGL	0.058	0.477	0.545	0.106	1.000	-0.362	-0.166
USBMMY	0.025	0.011	-0.083	-0.101	-0.362	1.000	0.456
USGG10	-0.042	0.295	0.169	0.175	-0.166	0.456	1.000

[Figure 2 – source: Bloomberg]

However, despite what seem to be a few not-so-favorable statistics (volatility, Sharpe Ratio, and Max DD), the argument for Bitcoin's diversification factor within a portfolio is shown to be true (as seen in Figure 2). The correlation matrix above reveals that Bitcoin is likely to move in a different (or even opposite) direction, relative to the other securities in the portfolio.

The extremely low values, which are all close to zero, support the fact that it would be a good addition for any traditional (or diversified) portfolio. Simply adding securities to a portfolio cannot necessarily produce good diversification results (especially in the long-run). Yet, in this case, it is quite clear that, at the very least, Bitcoin adds some level of diversification to the portfolio. Although it is a risky asset, this is likely to help the overall performance of the portfolio.

This model, provided by Faber, created the framework for a further simplification in the portfolios. This simplification is merited because the specific interest of this study was to see the effect of Bitcoin on a portfolio's returns.

Portfolio Stratifications:

	Equity	Fixed Income	Bitcoin (XBTUSD)
Portfolio 1	60%	40%	0%
Portfolio 2	60%	35%	5%
Portfolio 3	55%	35%	10%
Portfolio 4	55%	30%	15%
Portfolio 5	50%	30%	20%

[Figure 3]

Figure 3 (see above) shows how the portfolios in the subsequent section are divided. Starting off, there will be an allocation of 60% equity (**SPY US Equity** - seeks to provide investment results that, before expenses, correspond generally to the price and yield performance of the S&P 500), 40% fixed income (**AGG US Equity** - seeks to track the investment results of an index composed of the total U.S. investment-grade bond market), and 0% Bitcoin (**XBTUSD**). That scale adjusts as the portfolios go forward. Smaller portions of equity and fixed income are used, while Bitcoin's allocation grows. More on how the portfolios were formed is in the following section "Data".

It is important to also note that this model will be slightly skewed in favor of adding Bitcoin to one's portfolio. However, the purpose of this paper is to show the potential benefits (diversification, high returns, future profitability of the underlying technology), and it ultimately does that. This was simply worth pointing out as a potential shortcoming of the experiment.

Obviously, ways to interpret better and more improved methods will come with time. This was simply meant to be a starting point for further exploration in the space of cryptocurrencies, risky investments (or assets) and so on.

IV – Data:

The data utilized for the theoretical portfolios was drawn from the datasets of Bloomberg Professional Services. All the data extracted from the Bloomberg Terminal was from the same period that was used in the previous section "The Model" (March 30, 2011 – March 30, 2018). It is important to note that this period was used because it provided the earliest and most relevant price information on Bitcoin.

A) First, the results of how the **passive** portfolios performed.

Passive Portfolio Returns (3/30/2011 – 3/30/2018):

Passive	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Asset Return (%)
Equity (SPY)	60%	60%	55%	55%	50%	102.65
Fixed Income (AGG)	40%	35%	35%	30%	30%	2.42
Bitcoin (XBTUSD)	0%	5%	10%	15%	20%	874,664.47
Total Return (%)	62.56	43,795.66	87,523.75	131,256.85	174,984.95	

[Figure 4 – source: Bloomberg]

The passive portfolio (figure 4) strategy was simply a 'buy and hold' scenario. There was no active trading on Bitcoin within this set of portfolios. While the returns are good, especially as more Bitcoin is added to the portfolio(s), that was likely to be the case, given Bitcoin's meteoric rise in value. The next section (B) outlines a different strategy for the same portfolios used in figure 4. The differences in outcomes are truly fascinating.

B) Second, the results of how the **active** portfolios performed.

Active Portfolio Returns (3/30/2011 – 3/30/2018):

Active	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5	Asset Return (%)
Equity (SPY)	60%	60%	55%	55%	50%	102.65
Fixed Income (AGG)	40%	35%	35%	30%	30%	2.42
Bitcoin (XBTUSD)	0%	5%	10%	15%	20%	1,378,490.52
Total Return (%)	62.56	68,986.96	137,906.36	206,830.76	275,750.16	

[Figure 5 – source: Bloomberg]

The active portfolio (figure 5) strategy was to 'exit long' when the price of Bitcoin dropped below the 20-day simple moving average, and to go 'enter long' when the price of Bitcoin rose above the 20-day simple moving average. The belief was that trading the asset against its 20-day simple moving average would cancel out the 'noise' (due to frequent price changes) and yield the best returns. A table, which outlines all the trades made in the active strategy portfolio, can be found in the appendix of this paper (figure A).

V – Results & Analysis:

The returns for each portfolio (passive and active) progressively got better as a higher percentage of Bitcoin was put into each. Each 'total return' was calculated by multiplying the respective asset's return by its respective weight within the portfolio and adding the products together. For example, take portfolio 2 (active): [(102.65% * 60%) + (2.42% * 35%) + (1,378,490.52% * 5%)] = 68,986.96%. However, it becomes more and more clear that the actively managed portfolio experienced even better returns than the passively managed portfolio.

In every type of portfolio constructed, the actively managed approach outperformed the passively managed approach by a wide margin. It is important to also remember that the active trading was only taking place with Bitcoin. Therefore, the returns of SPY and AGG are the same in both portfolios. The only difference is that the active portfolios were trading Bitcoin relative to its 20-day simple moving average. By effectively "covering" one's downside (and artificially mitigating Bitcoin's price volatility), the returns are staggering. In a sense, it is a way to block out the ever-present 'noise' surrounding the cryptocurrency in today's markets.

These results are also in-line with the study this research's framework was built upon. In his paper, "A Quantitative Approach to Tactical Asset Allocation", Mebane T. Faber showed that a diversified portfolio could gain greater returns by simply protecting itself against a simple moving average. While Faber used the 200-day simple moving average, this research used the 20-day simple moving average. The hope was to account for Bitcoin's extreme price volatility and, luckily, that notion persevered. Furthermore, the 20-day simple moving average was chosen over other simple moving averages because it produced the most promising results (early in the research, compared to others).

This finding is extremely important for several reasons. For starters, it helps support the fact that Bitcoin, although risky, can be used as a meaningful (and effective) way to diversify a portfolio for positive returns. Secondly, it hints at the fact that investing in Bitcoin might not be that risky if investors are able to hedge their positions in the cryptocurrency. Simple moving averages are often used as a means of hedging, but the results in this study further support that the methodology not only works, but that it works well. It is, essentially, a way to 'juice' returns and provides an ideology on how to approach investments in risky assets for the future.

VI – Potential Limitations:

While the results of this paper are certainly promising, it is still important to mention shortfalls in the study's methodology. For one thing, Bitcoin is still (for all intents and purposes) an extremely new asset. The biggest question mark surrounding Bitcoin is its true value. Many experts continue to argue what its valuation really is. Some raise the point that it should simply be treated as a commodity (like gold); however, others see it as the way of the future and claim that its underlying technology, regardless of the actual asset's value, is worth investing in.

While much of this is still left up to debate, it is simply worth noting that data is still limited. For example, this study was only able to include 7 years of data, while Faber (in his paper) examined nearly 40 years of data. It is, therefore, hard to put too much faith into something that still has many questions yet to be answered.

Also, as was mentioned earlier, there is clearly a strong bias to include Bitcoin within a diversified (or traditional) portfolio because of its incredible returns over the period examined. This is the result of a bullish market surrounding both cryptocurrencies and technology in

general. As of late, Bitcoin has been experiencing more and more price corrections, since its loftiest valuation of roughly $19,000. Future studies will hopefully be more accurate, as a more appropriate (and permanent) price of Bitcoin might be determined by then.

Additionally, this paper focused exclusively on Bitcoin. That is not to say that an active (or passive) strategy would work for other cryptocurrencies, but it should be approached with caution if someone is trying to implement either of these strategies in their current portfolio with other risky assets.

Lastly, this research was completely 'backward-looking' in its analysis. So, in a sense, the value of its outcomes can be left up for further debate. While it is nice to be able to back-test and see what "could have been", ultimately, the goal is to be forward looking. Perhaps, future studies on this topic can use this paper as a model for predicting the future.

VII – Conclusion:

As previously stated, the purpose of this paper was to both argue for the inclusion of Bitcoin in any diversified (or traditional) portfolio and discover whether active or passive strategies yielded better returns. While there are many reasons why someone should invest in Bitcoin, it does not come without its potential limitations too. The pros and cons of investing in this cryptocurrency were discussed at length. While the currency itself shows plenty of promise, so does its underlying technology – blockchain (eliminating the need for third parties). However, the risks must be noted as well – price volatility, differing regulation across many countries, and still a way to go before a major portion of the public is willing to accept and use it.

By modeling a previous study, which outlines a technique to invest in risky assets, a model was used to evaluate the performance of portfolios with differing allocations of Bitcoin. Furthermore, the portfolios were divided into two separate groups: passive and active. The results showed that both sets of portfolios yielded greater returns with larger allocations of Bitcoin. However, the active portfolio yielded far superior returns to that of the passive portfolio. The active strategy was tied to the 20-day simple moving average to account for Bitcoin's frequent price changes. An 'enter long' position was taken when the price of Bitcoin crossed above the 20-day simple moving average; an 'exit long' position was taken when the price of Bitcoin crossed below the 20-day simple moving average.

In conclusion, this study does show that Bitcoin can be a strong asset within any "diversified" portfolio. It offers a high return for its rather high-risk premium and does not move in correlation to other financial securities. On top of that, the riskiness of Bitcoin might be able to be mitigated by actively trading it, compared to some simple moving average. This study utilized the 20-day simple moving average, but this begs another question: what about other simple moving averages? The possibility remains that other simple moving averages might be even more useful in trading Bitcoin. At first glance, the simple 20-day moving average appeared to be the best, but further study is probably necessary.

Also, a look into whether other cryptocurrencies performances will be correlated to Bitcoin's performance is another interesting topic. Right now, other cryptocurrencies (Ethereum, Litecoin, and Ripple) are so new that there isn't much data on them. However, in the next few months (or years), it might be plausible to track correlations between all the cryptocurrencies and their respective price movements to create some sort of diversified cryptocurrency portfolio. Lastly, further research, regarding GBTC (Bitcoin Investment Trust) should be explored, as it is currently the only way for traders to speculate against the price of Bitcoin. Potential studies on GBTC's premium (or discount) with relation to Bitcoin's price, as a sort of buying (or selling) signal could be promising.

Clearly, there is still a lot that must be discovered about Bitcoin (and other cryptocurrencies) in the next few months and years. With so much hysteria, promise, and even some skepticism, the possibilities seem endless for this new asset class. However, it is safe to say that Bitcoin will certainly stay relevant, not just for now, but well into the future too.

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Appendix

Active Trading Strategy Table:

Trade #	Position	Entry Rule	Entry Date	Entry Price	Exit Rule	Exit Date	Exit Price	Size	Trade P&L	Cum. P&L	Total Return
1	Long	1	04/13/11	0.92	2	07/01/11	15.4	1	14.48	14.48	1448.00
2	Long	1	08/22/11	10.9	2	08/23/11	10.94	1	0.04	14.52	0.26
3	Long	1	08/25/11	9.66	2	08/26/11	8.18	1	-1.48	13.04	-9.54
4	Long	1	11/09/11	2.95	2	11/10/11	2.84	4	-0.44	12.6	-3.13
5	Long	1	11/14/11	2.22	2	11/15/11	2.33	6	0.66	13.26	4.85
6	Long	1	11/30/11	2.97	2	01/26/12	5.34	4	9.48	22.74	66.48
7	Long	1	02/13/12	5.26	2	02/14/12	4.46	4	-3.2	19.54	-13.48
8	Long	1	03/06/12	4.99	2	03/20/12	4.84	4	-0.6	18.94	-2.92
9	Long	1	04/03/12	4.95	2	04/05/12	4.92	4	-0.12	18.82	-0.60
10	Long	1	04/09/12	4.87	2	04/10/12	4.84	4	-0.12	18.7	-0.61
11	Long	1	04/12/12	4.92	2	05/01/12	5	4	0.32	19.02	1.62
12	Long	1	05/03/12	5.13	2	05/09/12	5.04	3	-0.27	18.75	-1.35
13	Long	1	05/17/12	5.1	2	08/21/12	9.92	3	14.46	33.21	73.22

14	Long	1	09/07/12	11	2	09/10/12	11.17	3	0.51	33.72	1.49
15	Long	1	09/11/12	11.33	2	10/09/12	11.9	3	1.71	35.43	4.93
16	Long	1	11/16/12	11.75	2	12/31/12	13.51	3	5.28	40.71	14.49
17	Long	1	01/01/13	13.3	2	01/02/13	13.28	3	-0.06	40.65	-0.14
18	Long	1	01/07/13	13.59	2	04/12/13	110	3	289.23	329.88	694.43
19	Long	1	04/15/13	91	2	04/16/13	75.6	3	-46.2	283.68	-13.96
20	Long	1	04/19/13	118	2	04/22/13	127.9	2	19.8	303.48	6.96
21	Long	1	04/23/13	145.38	2	04/26/13	136.8	2	-17.16	286.32	-5.64
22	Long	1	04/29/13	144.5	2	05/01/13	118.74	1	-25.76	260.56	-8.97
23	Long	1	05/20/13	122.4	2	06/05/13	121.5	2	-1.8	258.76	-0.69
24	Long	1	07/12/13	90.9	2	07/15/13	98.98	2	16.16	274.92	6.22
25	Long	1	07/16/13	98.95	2	07/18/13	89.03	2	-19.84	255.08	-7.19
26	Long	1	07/22/13	92.77	2	08/12/13	95.52	2	5.5	260.58	2.15
27	Long	1	08/13/13	99.65	2	09/23/13	122.99	2	46.68	307.26	17.85
28	Long	1	09/25/13	124.33	2	09/26/13	126.4	2	4.14	311.4	1.34

29	Long	1	09/27/13	126.1	2	10/03/13	119.12	2	-13.96	297.44	-4.47
30	Long	1	10/09/13	126	2	12/09/13	926.0001	2	1600.0002	1897.4402	536.12
31	Long	1	12/10/13	942.7301	2	12/16/13	729.3601	2	-426.74	1470.7002	-22.48
32	Long	1	01/02/14	785.1701	2	01/24/14	793.4901	1	8.32	1479.0202	0.57
33	Long	1	03/04/14	672.1001	2	03/20/14	581.8401	2	-180.52	1298.5002	-12.20
34	Long	1	04/16/14	517.5901	2	04/21/14	476.2001	2	-82.78	1215.7202	-6.37
35	Long	1	04/22/14	503.7001	2	04/28/14	450.7601	2	-105.88	1109.8402	-8.70
36	Long	1	05/21/14	491.5951	2	06/16/14	567.4725	2	151.7548	1261.595	13.66
37	Long	1	06/18/14	606.5625	2	06/19/14	604.3575	2	-4.41	1257.185	-0.35
38	Long	1	07/01/14	646.1301	2	07/24/14	620	1	-26.1301	1231.0549	-2.08
39	Long	1	10/15/14	407.1625	2	10/17/14	383.475	3	-71.0625	1159.9924	-5.77
40	Long	1	10/21/14	384.4449	2	10/24/14	359.71	3	-74.2047	1085.7877	-6.39
41	Long	1	11/11/14	365.92	2	11/21/14	357.965	2	-15.91	1069.8777	-1.46
42	Long	1	11/25/14	378.725	2	12/05/14	372.94	2	-11.57	1058.3077	-1.08
43	Long	1	12/08/14	377.24	2	12/09/14	367.6839	2	-19.1122	1039.1955	-1.80

#	Type		Date	Price		Date	Price				%
44	Long	1	01/27/15	271.9124	2	01/29/15	236.21	3	-107.1072	932.0883	-10.30
45	Long	1	02/16/15	244.185	2	03/19/15	263.2725	3	57.2625	989.3508	6.14
46	Long	1	05/01/15	236.5813	2	05/19/15	232.0825	4	-17.9952	971.3556	-1.82
47	Long	1	05/22/15	235.5138	2	05/26/15	235.57	4	0.2248	971.5804	0.02
48	Long	1	06/16/15	235.955	2	08/06/15	282.3662	4	185.6448	1157.2252	19.09
49	Long	1	09/08/15	240.79	2	09/15/15	231.365	4	-37.7	1119.5252	-3.25
50	Long	1	09/18/15	233.185	2	09/22/15	227.51	4	-22.7	1096.8252	-2.03
51	Long	1	09/25/15	235.4625	2	11/12/15	307.9075	4	289.78	1386.6052	26.40
52	Long	1	11/13/15	326.5002	2	11/20/15	328.2899	4	7.1588	1393.764	0.52
53	Long	1	11/27/15	349.5675	2	12/29/15	419.02	3	208.3575	1602.1215	14.94
54	Long	1	12/30/15	428.9263	2	12/31/15	427.125	3	-5.4039	1596.7176	-0.34
55	Long	1	01/08/16	455.36	2	01/14/16	428.835	3	-79.575	1517.1426	-4.98
56	Long	1	02/16/16	396.1251	2	03/09/16	411.3551	3	45.69	1562.8326	3.01
57	Long	1	03/24/16	418.335	2	03/25/16	415.955	3	-7.14	1555.6926	-0.46
58	Long	1	03/29/16	421.9351	2	03/30/16	415.01	3	-20.7753	1534.9173	-1.33

#			Date	Price		Date	Price		Amount	Cumulative	%
59	Long	1	04/01/16	416.7451	2	05/18/16	453.655	3	110.7297	1645.647	7.21
60	Long	1	05/19/16	454.6926	2	05/20/16	443.1349	3	-34.6731	1610.9739	-2.11
61	Long	1	05/27/16	452.995	2	06/24/16	613.3751	3	481.1403	2092.1142	29.85
62	Long	1	06/27/16	633.454	2	06/30/16	638.9551	3	16.5033	2108.6175	0.79
63	Long	1	07/01/16	665.29	2	07/08/16	621.26	3	-132.09	1976.5275	-6.26
64	Long	1	07/18/16	681.5399	2	07/25/16	661.7275	2	-39.6248	1936.9027	-2.00
65	Long	1	09/06/16	607.8839	2	09/22/16	595.3051	3	-37.7364	1899.1663	-1.95
66	Long	1	09/26/16	598.905	2	09/28/16	602.9451	3	12.1203	1911.2866	0.64
67	Long	1	09/30/16	606.5234	2	10/03/16	609.425	3	8.7048	1919.9914	0.46
68	Long	1	10/04/16	612.5751	2	01/12/17	789.1077	3	529.5978	2449.5892	27.57
69	Long	1	01/24/17	920.78	2	01/25/17	898.191	2	-45.178	2404.4112	-1.84
70	Long	1	01/27/17	913.25	2	03/13/17	1230.665	2	634.83	3039.2412	26.39
71	Long	1	03/14/17	1237.4978	2	03/17/17	1148.491	2	-178.0136	2861.2276	-5.86
72	Long	1	04/04/17	1153.8298	2	06/16/17	2360.4551	2	2413.2506	5274.4782	84.31
73	Long	1	06/20/17	2573.1719	2	06/27/17	2347.3149	2	-451.714	4822.7642	-8.56

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74	Long	1	07/06/17	2611.0859	2	07/10/17	2535.917	1	-75.1689	4747.5953	-1.56
75	Long	1	07/21/17	2729.8398	2	07/26/17	2468.99	1	-260.8498	4486.7455	-5.49
76	Long	1	07/27/17	2503.2939	2	09/11/17	4330.8906	1	1827.5967	6314.3422	40.72
77	Long	1	09/28/17	4154.2656	2	12/25/17	13082.833	1	8928.5674	15242.9096	141.38
78	Long	1	02/16/18	9868.916	2	03/08/18	9939.5254	1	70.6094	15313.519	0.46

[Figure A – source: Bloomberg]